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Sports Lighting

By M. W. PEIRCE *(Fellow)*

Summary

In this paper lighting requirements of various indoor and outdoor sports are discussed, together with some of the problems involved in finding satisfactory solutions. Costly equipment and exceptionally high intensities are only required where there are large numbers of spectators, and effective lighting for play can usually be simple and inexpensive. Suggestions are made what to look for in judging the success or otherwise of a particular installation for a number of sports. The lighting of football fields is dealt with at some length both as regards the fundamental considerations and the practical problems of aiming and focusing the floodlights.

(1) Introduction

After leaving school most people find that the greater part of the time available to them for sport and recreation is during the hours of darkness. In winter they must wait till the week-end for any activity requiring daylight, and even in the summer may find that the low altitude of the sun is an annoyance which reduces the pleasure of certain games.

In the Universities and in the Services the value of organised sport is fully recognised. All are encouraged to take part in some form of activity and timetables usually leave the afternoons free for this purpose. In the business world such arrangements are impracticable, and the solution seems to be to provide increased opportunities for recreation after dark.

A study of the lighting requirements for various sports shows that costly equipment and exceptionally high values of illumination are only required when there are large numbers of spectators, and that effective lighting for play can be simple and inexpensive. When lighting adequate for watching games is installed, the sponsors will expect a reasonable return on their invested capital, and this will depend on the number of spectators attracted; where the lighting is designed only for playing, the players or club concerned will wish to have the best possible conditions for play at the minimum cost in the form of subscriptions. The measure of success in the latter class must be the amount of support which is regularly given by the playing members over a period of time.

(2) Fundamental Considerations

(2.1) Illumination Values

Sufficient light must be provided to allow the players and the spectators, if there are any, to follow the niceties of the game. In ball games the illumination of the ball as it moves in the air must be kept as nearly constant as possible, the illumination of the court being of secondary importance. It must be remembered that the player keeps his eye on the ball rather than on the court.

(2.2) Glare

The lighting scheme for any particular sport must be designed to minimise glare; in any competitive game it is important that any unavoidable glare should affect each player equally. If the lighting is symmetrically arranged with respect to the playing area this will be achieved and will result in an enjoyable game for the players. Natural lighting in the evening may leave much to be desired in this respect, and games such as lawn tennis may be quite spoilt by glare from the sun immediately behind one of the players.

The author is with the General Electric Co., Ltd., London. The manuscript of this paper was first received on December 12, 1952, and in revised form on January 5, 1953. The paper was presented at a meeting of the Society held in London on April 14, 1953.

(2.3) The Background of a Moving Object

Where a game is played with a moving object which must be closely followed by the players, the background against which the object is seen must be carefully considered. A perfectly plain black background with a white ball may not be as satisfactory as a background having some pattern against which speed of movement can be quickly seen. On the other hand a background of black and white stripes like a zebra crossing would be most unsuitable.

Games such as lawn tennis or football played in the open under artificial light are liable to suffer from absence of pattern in the background, and it has been noted that a ball in the air moving towards a player appears to "hang" in space for a few moments and then arrive before it is expected.

(2.4) Obstacles to Vision

Spectators wish to see as much of the play as possible. Any supports to lighting fittings should be positioned so that they do not obstruct the view, or if this is not possible, they should present the minimum obstruction.

(2.5) Spectacular Effects

Special lighting to enhance the spectacular effect and to attract spectators may involve considerable elaboration of the lighting scheme, and indeed there is room for ingenuity on the part of the lighting engineer in devising effects purely for spectacular purposes.

Apart from special effects of this type, the appearance of say the ribbon of a greyhound track before the race commences, or of a football field before the game, needs consideration if spectators are to be attracted.

(3) Boxing

The lighting requirements for boxing provide an excellent example of the elaboration necessary to provide for numbers of spectators. There cannot be very many gymnasia where there is not sufficient general lighting to allow practice bouts to take place under perfectly satisfactory conditions. For a big fight, however, the amount of light can hardly be too great, and the heat that goes with these high values of illumination is a discomfort with which the boxers must contend as best they can.

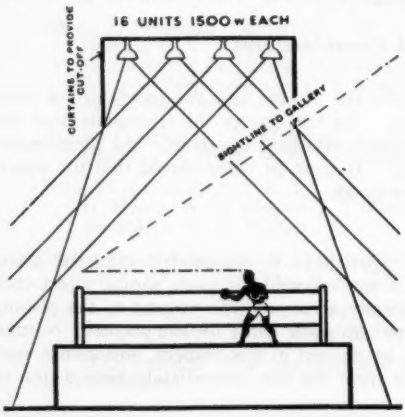


Fig. 1. Diagrammatic representation of boxing ring lighting.

The method usually used to confine the light to the ring and give a cut-off as complete as possible at the ringside is illustrated in Fig. 1. The level of the bottom of the curtain above the ring is controlled by the sight line from the farthest spectator. The curtain is approximately 6 ft. deep and is usually taken round the four sides of the frame, although additional cross curtains have been used dividing the frame into four compartments and giving still greater control of cut-off.

For the big fights, 16 or more 1,500-watt lamps are used in concentrating reflectors, but where the number of spectators is fewer and they are consequently closer to the ring, smaller

frames arranged for four or five 500-watt reflectors can be used. The frames are usually suspended by wire ropes controlled by winches so that they can be lowered into position when required.

(4) Race Tracks

(4.1) Greyhound Tracks

Here large numbers of spectators are regularly catered for, and the lighting result considered as a spectacle is all important. Devices of showmanship such as separately controlled stand lighting, which can be switched off during the period of each race, are common and effective.

The spectacular effect is increased if the ribbon of the track is brightly lighted and sharply defined and, as it is a horizontal surface, the position of the lighting fittings might be considered immaterial. The position of the lighting fittings, however, has an important bearing on the ability of a spectator to follow his particular fancy during the race. The difficulty of picking out the coat colour does not arise when the dogs are near the spectator, but it does arise when they are at the far side of the track. It is desirable that the track should be lighted from positions near or over the inner fence, as there is then more light on the vertical sides of the dogs as seen from remote parts of the track.

In order to minimise obstructions to vision the number of fittings are kept to a minimum. There is no necessity to use more than one row of lighting fittings and the diameter of the supporting poles must be as small as possible—even to the extent of allowing some movement in high winds. A type of fitting using three reflectors is illustrated in Fig. 2. This fitting is designed for mounting about 13 ft. above the track and spaced at centres up to twice the mounting height; it should be fixed over a line approximately 4 ft. from the inside fence of the track and the spacing kept even along this line.

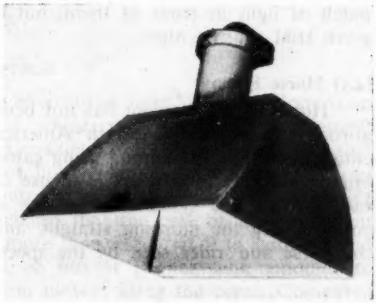


Fig. 2. Three-way reflector designed for race track lighting.

(4.2) Speedway Tracks

Almost invariably a speedway track is combined with a greyhound track. It is rather wider than the greyhound track at the sides and considerably wider at the ends. As it is not possible to situate poles inside the speedway track within 12 ft. of the edge because of the danger of accidents, as much as possible of the lighting is done from the outside of the track. The fittings should preferably be about 16 ft. above the track to ensure that the full width is illuminated, and poles having a projection of some 12 ft. are frequently used. Here again it is desirable to illuminate the vertical plane as seen from the opposite side of the track, and it is usual to mount, say, six 1,000-watt floodlights on poles in the centre of the ground at each end to provide this illumination from the inside at the bends.

(4.3) Poles for Track Lighting

For a projection of 4 ft. and a mounting height of 13 ft., a simple steel pole of 2-in. outside diameter with a bend about 4 ft. above the ground is satisfactory, and offers little obstruction to vision. With these poles it is usual to use a side entry type fitting.

For the lighting of a combined greyhound/speedway track it is desirable that the poles should be rotatable to illuminate either track at will. In order to provide the

different projections over the two tracks, a pole having a projection of 10 ft. is used and is rotated only until the required position is achieved; Fig. 3 illustrates this arrangement. It is necessary to rotate the fitting with respect to the pole in addition to rotating the pole itself. The locking arrangements must hold the pole very securely if the installation is not to look untidy after a high wind.

Collapsible poles have the advantage that the centre of the ground can be used in the daytime with the track lighting equipment out of sight; further, fittings can be cleaned and re-lamped without the use of ladders.

Figs. 4 and 5 show poles typical of the types referred to.

(4.4) Photo Finish Equipment

The special lighting required for photo finish cameras is usually obtained from a continuous trough fitting mounted across and about 10 ft. above the track at the finishing line. Horizon type lamps of 1,000 watts are used, spaced about 2 ft. apart in concentrating reflectors. The object is to produce an illuminated band about 4 ft. wide with good illumination on both sides of the dogs. When first installed these lights occasionally cause trouble because some dogs are inclined to shy at the bright patch of light in front of them, but the difficulty can be overcome if the dogs are given trial runs at night.

(4.5) Horse Racing

Horse racing at night has not been practised in this country but is quite popular abroad, South Africa, South America and Australia all having illuminated racecourses. Overhead lighting using catenary suspension has been most frequently used, but one of the latest ideas is to use continuous trough reflectors at the level of the rail. Where this system is used the spectators are congregated on one side of the course along the finishing straight, and the lighting is arranged to light the side of the horse and rider seen by the spectators.

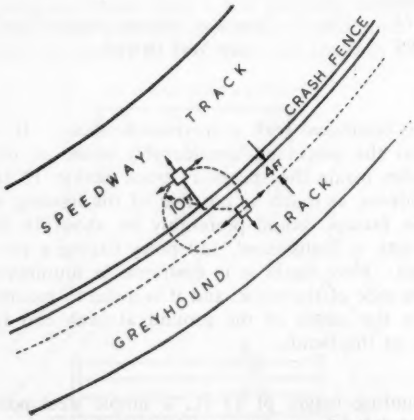


Fig. 3. (Above) Showing application of rotating pole to give 10-ft. projection over speedway track and 4-ft. projection over greyhound track.

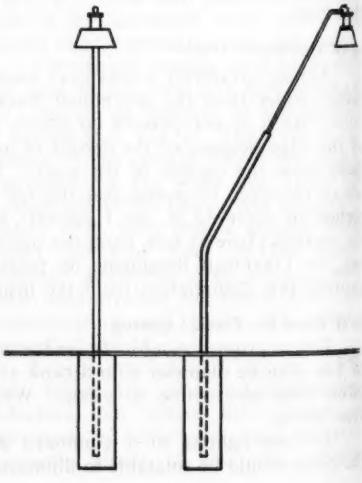
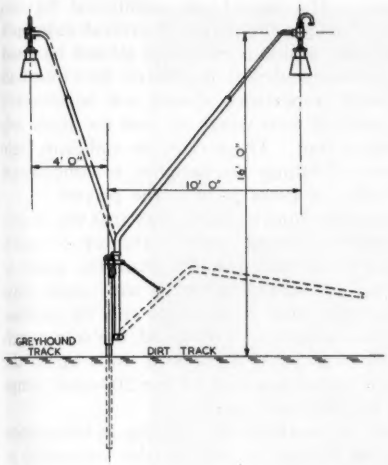


Fig. 4. (Right) Simple pole for track lighting with side entry fittings.



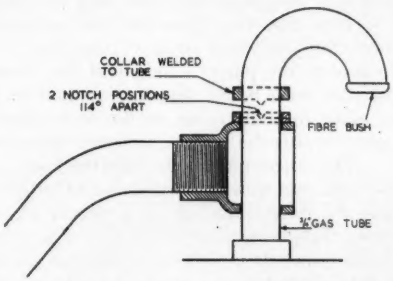


Fig. 5 (Left). Collapsible rotary pole for dual installation. (Above) Showing lantern locking arrangement.

(5) Lawn Tennis

It is surprising that more use is not made of artificial lighting for outdoor lawn tennis in this country. The load required for a single court with tungsten filament lamps is about 10 kw., allowing for ten lighting positions of 1,000-watts each, so that the running cost would be approximately 1s. per hour. The equipment required consists of vitreous enamelled angle reflectors mounted at a height of 20-25 ft. Suitable poles with reflectors would cost about £15 each, so that the cost of the equipment exclusive of wiring and erection should not be more than £150. If it is assumed that a complete installation costs £500, the interest on this at 10 per cent. amounts to only £1 per week, which could be recovered from players using the court. Compared with the cost of laying down a hard court, therefore, the additional cost of making it available after dark does not seem very great, and such a facility would receive popular support in almost every large town.

Comparing the game played in daylight with that played at night, the artificial lights probably cause less annoyance from glare than sunshine—particularly when the sun is low in the evening. Further, the playing conditions are more fair since the glare is the same for both sides.

There is at first some difficulty in judging the speed in flight of the ball in artificial light, possibly because the plain black background of the sky gives no pattern against which movement can be seen. The effect is that if, for instance, a ball is lobbed, it appears to hang a little in the air and then arrive rather sooner than it is expected. The night game seems faster, and usually gives the player the feeling that he is in good form. Fig. 6 shows a suggested layout for outdoor courts.

(6) Badminton

This game is normally played under cover and in artificial light. Only two lighting positions are required and these should be situated over or behind the net posts. The shuttle should always be seen as a bright object against a darker background, and this is possible with the arrangement of lighting mentioned because the shuttle feathers are translucent. The advantage gained by locating the lighting units at the net posts is that in these positions the fittings cause minimum interference with the players' vision. There are not many occasions when the shuttle in flight is seen in

silhouette against a fitting in these positions. The use of any additional lighting positions will not only introduce glare but may unsight the player at critical moments, and it is very important that only the two lighting positions per court should be used.

It is true that from the two positions recommended it is difficult to illuminate uniformly the floor of the court, but too much importance should not be attached to this as the player's judgment and experience tell him where to find the lines and his eyes must be on the shuttle when he plays a shot. There must be sufficient light to allow the umpire to see the lines clearly, but if fittings are designed to concentrate light towards the back lines there must inevitably be more glare to the players.

The object must be to light the "air" above the court in such a way that the shuttle will not pass quickly in and out of bright patches. Fittings open at the top in which only the downward light is screened are likely to be unsatisfactory from the point of view of lighting "in the air." Fig. 7 shows a badminton fitting with opal glass diffusing panels in which the light up and down the court is increased only by increasing the projected area in these directions. If the fitting is wall-mounted, the side panels placed at an angle to the wall, ensure that the brightness of the wall leads up to the brightness of the fittings. Home-made lighting units using four or five 200-watt lamps screened by butter muslin can be effective if not very permanent.

It is necessary to discuss some of the causes of unsatisfactory lighting in badminton halls because it does happen that well designed fittings are not equally successful in all situations. A great deal depends on the colour of the background against which the shuttle is seen. If the walls are very light in colour and the ceiling dark, there is a sudden change in background to the shuttle during its flight, which may cause difficulties. The walls should not be too light and the ceiling decoration not too dark for the best playing conditions. Fig. 8 is a photograph of a badminton court where the background brightnesses are not ideal but playing conditions are nevertheless quite satisfactory.

If two courts are arranged end to end, the lighting fittings of one court are likely

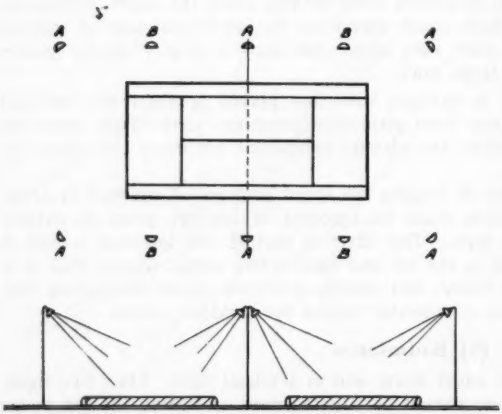


Fig. 6 (Above). Position of lighting units for lawn tennis. Units at points A only may be used but for best results units should also be installed at points B.

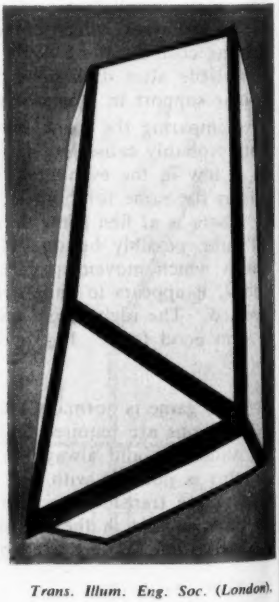


Fig. 7 (Right). Special lighting fitting for badminton.

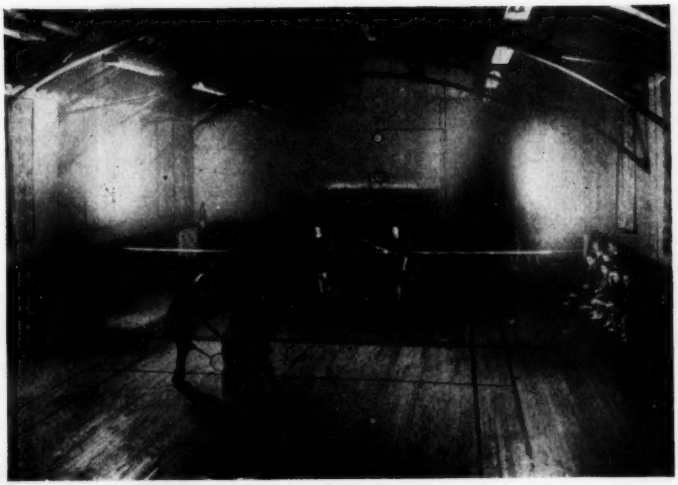


Fig. 8. Badminton court lighting using fitting shown in Fig. 7.

to interfere with the vision of players on the other, and it will be desirable to arrange screens, possibly in the form of curtains between the two courts.

(7) Squash Rackets

This is a popular game, and fair facilities exist, although quite a number of courts have no artificial lighting. It is a very fast game and a high illumination is required.

It is usual to use six vitreous enamelled reflectors each with a 300-watt filament lamp. Four reflectors are of the dispersive type and two angle reflectors are used near the front walls. Fluorescent lighting is satisfactory and the 300-watt units can be replaced with twin lamp 80-watt reflector-type fittings.

The high court of rather small dimensions with light coloured walls gives the lighting engineer almost ideal conditions and few technical difficulties. Fig. 9 shows a diagrammatic arrangement of lighting for a squash rackets court using twin fluorescent lamp fittings. If filament lamps are used the positions of the fittings are similar.

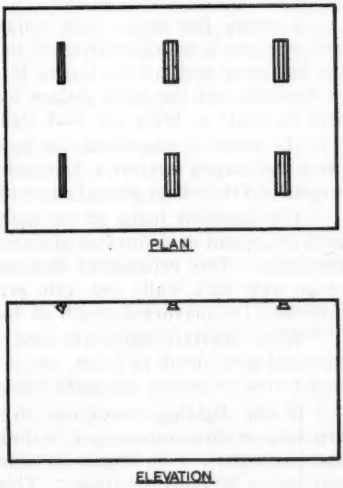


Fig. 9. Lighting arrangements for squash rackets.

(8) Cricket

The value of net practice is well appreciated, but indoor cricket schools are more numerous in Australia than in this country. With a capable coach they can be of the greatest value to players of any class of cricket. Fig. 10 shows a cricket school run by Alan Fairfax in the basement of Imperial Chemical House in 1930, and it will be seen that the equipment required is not very elaborate. The fittings are

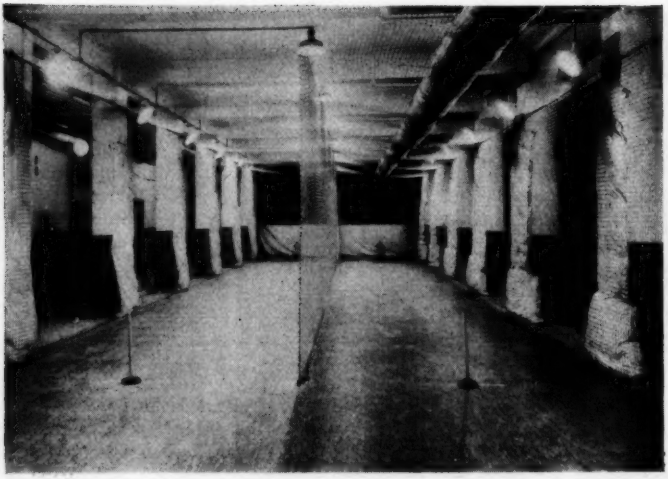


Fig. 10. Lighting of an indoor cricket school.

completely protected by the heavy netting which is used. No doubt, in these days, fluorescent lighting would be installed.

Players who have had experience of play under these conditions find it a most exhilarating form of exercise, and cricket schools in populous districts could be sure of plenty of public support, particularly as they would be free from the danger of "no play to-day" notices.

(9) Miniature Rifle Range

Lighting for indoor rifle ranges provides some interesting problems, and it is easy to make a wrong analysis of the task. In the first place the "object of regard" is the bull's-eye and not the target; in the second, the eye is asked to focus the foresight of the rifle and the more distant bull. Where open sights are used an attempt must also be made to bring the back-sight into focus.

In order to emphasise the bull at the expense of the target, it seems logical to place the targets against a light-coloured background, and experience shows that the targets and their background can with advantage be of the same colour and brightness.

The depth of focus of the marksman's eye might be increased by introducing a certain amount of controlled glare with the object of reducing the size of the iris to the minimum. This experiment has not yet been tried, but it would seem that a rifle range with dark walls and little general illumination will not provide the conditions necessary for maximum depth of focus.

When aperture sights are used, the small aperture of the foresight acts as a lens stop and gives depth of focus, and it is only necessary to step up the illumination of the target area to ensure adequate vision.

If the lighting conditions in a rifle range are not correct, the marksman's first two or three rounds will be fired satisfactorily, but before he gets to round ten—and particularly if he lingers in taking aim—the bull will tend to disappear completely just before he pulls the trigger. This seldom happens under daylight conditions out of doors, and it seems probable that it is connected with the general level of brightness rather than with brightness of the target area.

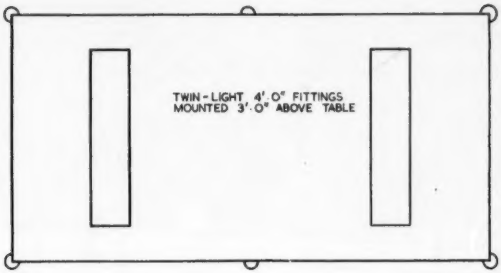


Fig. 11 (Above). Arrangement for lighting a billiards table.

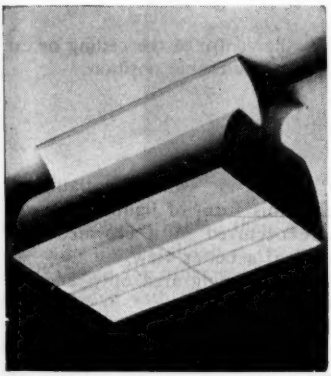


Fig. 12 (Left). A gymnasium lighting fitting.

(10) Billiards

Lighting fittings for billiard tables have in the past been large units comprising three reflectors of pyramid form, each with a 100-watt pearl lamp. Fluorescent lighting has been used, but not for first-class professional contests, as the use of a tubular light source means that the player will see line images on the ball, and this may prove a distraction of importance to experts. For ordinary players, however, it is not important, and fluorescent lighting is quite satisfactory.

It can be assumed that any arrangement of lights will illuminate the centre of the table satisfactorily, but many arrangements fail because they do not give sufficient light on the vertical surface of the cushions. To test the lighting of a billiard table, the black should be placed near the top pocket and the white at the other end of the table, so that it is just possible to pot the black by a very fine cut. To play this shot the player must be able to see the edge of the black ball against the face of the cushion; frequently this is not possible.

The simple arrangement shown in Fig. 11, in which two 4-ft. lamp reflectors are used, appears to give more satisfactory results than more ambitious reflector designs.

(11) Gymnasium Lighting

The requirements here are to give adequate lighting without glare and to guard against mechanical damage. It will not be wise to use glass as a diffusing medium, and yet the direct vision of a lamp filament may cause trouble for a person climbing a rope or the wall bars.

Fig. 12 illustrates a fitting constructed in sheet steel with louvering arranged to screen the lamp from direct vision. The overall efficiency is not high, but this type of

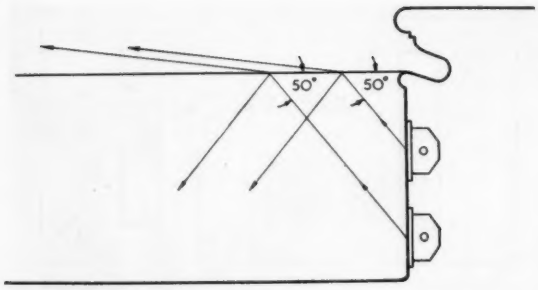


Fig. 13. An arrangement for underwater lighting showing how the water surface acts as a total reflector.

fitting solves the problem well. Such fittings can be in the centre of the ceiling or can be fixed in the angle of wall and ceiling—which is a less vulnerable position.

(12) Swimming Bath

(12.1) Underwater Lighting

The attractive effects achieved by underwater lighting of swimming baths are well known, but it is not so generally appreciated that this form of lighting makes a considerable contribution to safety. Fatalities have occurred in a crowded bath which could have been avoided if the attendant had had a better view.

The underwater lighting is sometimes restricted to the diving area only, and this can be almost as effective and at the same time less costly.

This form of lighting is best installed by building frames in the bath side and

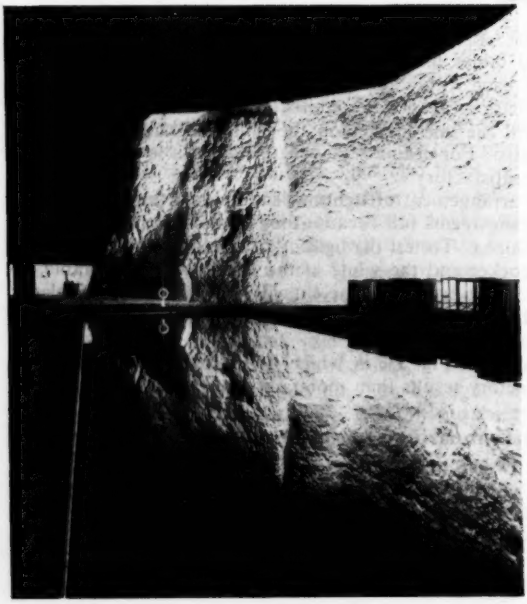


Fig. 14. An outdoor swimming pool lighted by reflection from the floodlighted white cliffs.

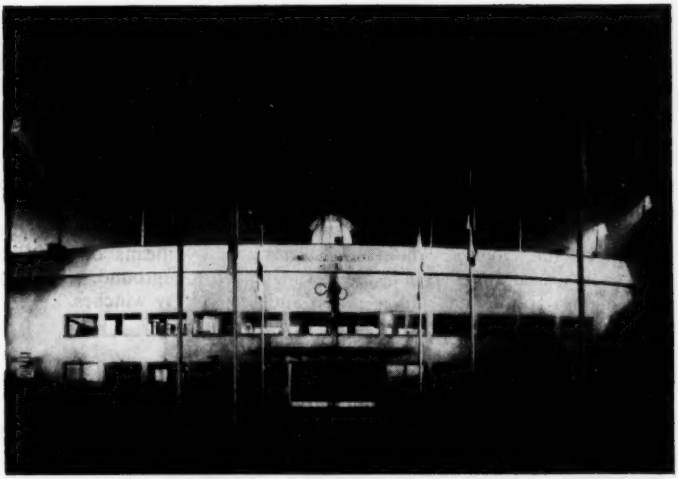


Fig. 15. The exterior of the Olympic winter sports stadium at Oslo, 1952.

fixing floodlights behind them. This is sometimes known as the "dry niche" system. Access to the floodlights is frequently from a passage-way round the bath, which may also be used for other services; alternatively, separate pits are made at each position and provided with the necessary drainage.

The frames should be quite close to the surface of the water because, as will be seen from Fig. 13, a greater area of water surface then acts as a total reflector of stray light from the floodlights.

(12.2) General Lighting

The equipment for overwater lighting of a swimming bath will probably include a good deal of showmanship. General lighting may be controlled by dimmers with special lighting confined to the water area for use during races or to the diving area during diving events. For indoor baths, co-operation at an early stage between the Architect and Lighting Engineer is particularly important, as besides the question of harmonising the lighting with the building there are such matters as access to the fittings to be considered.

Out-of-doors floodlighting can be effective and, again, dimming of part of the equipment may be required. Full use should be made of natural features and an example is given in Fig. 14 where general lighting is provided by floodlighting the white cliffs which enclose two sides of the bath.

(13) Areas

(13.1) Putting, Bowls, Curling

The lighting for areas such as these does not need much comment here. Poles with angle or scoop type reflectors and 1,000-watt lamps are commonly used and provide very effective lighting from the sides of the areas. Municipal seaside authorities almost without exception provide facilities for these games, and they are well patronised.

(13.2) Ice Rinks

In this country ice rinks are mostly indoors and illuminated from above with high wattage lamps in concentrating reflectors. As the mounting height is consider-

able compared with the spacing required for adequate lighting, it is usual to group three or more fittings together on a small frame fitted to raising and lowering gear for re-lamping. The white surface of the ice provides ideal conditions for ice-hockey and the spectator is able to follow every detail of the game.

In Oslo there are a number of stadia for skating and ice-hockey in the open air, and most of these are illuminated at night. At one stadium two big catenary cables are carried from end to end of the banking, and each supports a row of 1,500-watt fittings. The fittings are designed as far as posible to prevent snow settling on them, as when the snow melts the drips are apt to make holes in the ice below.

The photograph, Fig. 15, is of the stadium in Oslo during the Winter Sports section of the Olympic Games. Lighting is by means of floodlights arranged in banks of six on poles round the perimeter of the ground. The six floodlights are carried on a frame and can be raised and lowered by winches.

(14) Football

(14.1) Early Football Floodlighting

The idea of floodlighted football is not as new as some might think. The following advertisement appeared in the "Glasgow Herald" over 64 years ago in 1888:—

GREAT FOOTBALL MATCHES
with the aid of the
"WELLS' LIGHT"
(WALLWORK & WELLS' PATENT)

This Light has the reputation of being possessed of the finest illuminating properties and, excellently adapted as it is for the purposes of outdoor recreation, the short series of Evening Matches arranged by the Executive should not only prove interesting in the sense of novelty but at the same time show the scientific and practical uses of such illumination. The Lights have been kindly supplied by
MESSRS. JOHN DOLAND AND SON, of this city

VALE OF LEVAN
versus
RANGERS
To-night, 6th November
Kick-off, 7 o'clock
Grandstands.—University Side, 1s. Infirmary Side, 6d.

It seems that there were 10,000 oil lamps each of which was said to give a light of 4,000-candle-power. If this was true the total candle-power was rather more than would be considered sufficient to-day.

(14.2) Methods of Lighting

At least one football floodlighting installation with the lights held by catenary suspensions above the ground exists in South America, but there are so many objections to the use of this system on grounds in this country that it need not be considered here.

The greater number of grounds use floodlights on four or more towers, or alternatively groups of floodlights on a number of poles spaced all round the ground. In general the latter system is only suitable for smaller grounds, and for large stadia capable of holding many thousands of spectators the four-tower system should be used. If the floodlights are high enough there is less glare with this system, though it must be admitted that in fog long-throw floodlights are at a disadvantage.

(14.3) Mounting Height

The mounting height of the lighting units is the chief factor controlling glare to the players and especially to the spectators. Fig. 16 shows how, from the higher

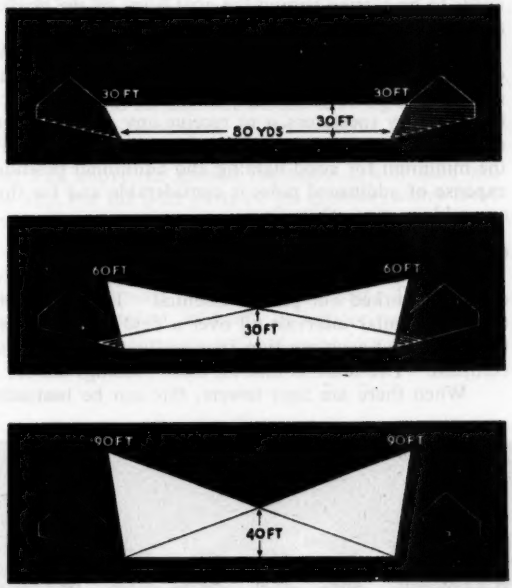
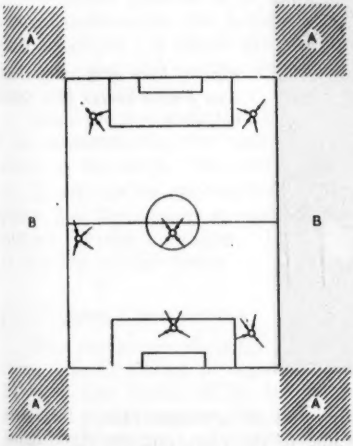


Fig. 16 (Right). Showing the effect of mounting height on glare in the eyes of spectators.

Fig. 17 (Below). Plan of football field showing areas which may be used for groups of floodlights.



mounting positions, it is possible to confine the light more closely to the field of play without spilling on to the spectators; 80/100 ft. should be considered a minimum height for an installation where there may be 60,000/100,000 spectators.

(4.4) Number of Lighting Positions

If 100 floodlights are to be used for illuminating a football ground, it is possible to arrange them in any number of groups from one to one hundred, and it is necessary to decide which combination will give the best results. Quite obviously a single group of 100 floodlights would not do, as the game could be seen from one direction only and only one side of the ball would be illuminated.

On the other hand, it is possible to light all sides of the ball wherever it may go on or over the playing field, from four positions, if these are correctly chosen. Four positions, therefore, must be considered the minimum number of groups.

If it happens to be convenient, say from a continuous stand all round the ground, to string the floodlights in a continuous line, it might be thought that this arrangement would give better results than grouping. In practice it is probable, however, that the glare will be worse because one cannot get away from it. In any event, such a system

needs to be carried behind the goal lines, or the goalkeepers will not see an illuminated area of the ball.

In the opinion of the author, the well-known Arsenal installation, good as it is, can be criticised from this point of view. Fig. 17 shows a plan of a football ground and its surroundings, and it seems clear that if the section of the ball seen by the goalkeeper or by spectators is to receive any direct illumination, then some of the lighting units must be situated in the areas marked "A." Positions in these four areas are the minimum for good lighting and additional positions can be used if desired, but the expense of additional poles is considerable and for this reason if towers are used there are seldom more than four.

(14.5) Training the Floodlights

When there are 100 or more floodlights to be correctly focused and trained, a carefully worked out plan is essential. The illumination on vertical planes should be taken at regular intervals all over a field and at a height of approximately 5 ft. above the ground; at each position four readings should be taken from the four points of the compass. The ideal is that all these readings should be equal.

When there are four towers, this can be best achieved by working on one tower

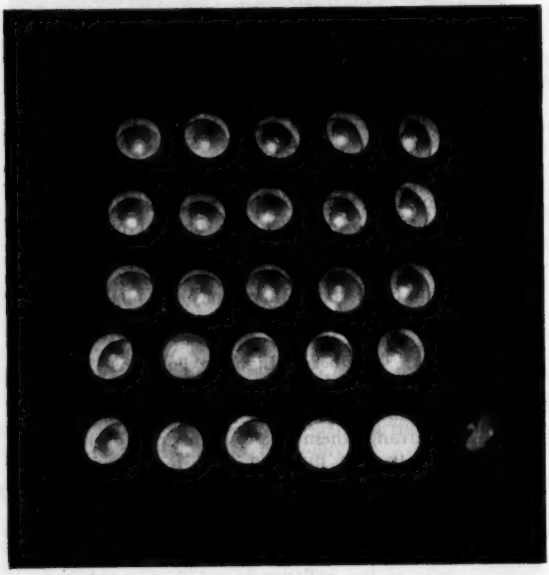


Fig. 18. View of floodlights as seen from a corner of a football field.

at a time and training the floodlights, in the daytime, to a pre-arranged plan. Pegs are put in the ground, one for each floodlight, according to the plan, and the floodlights trained one at a time to a person who stands at each peg in turn. This can be done quite simply and in daylight, if the person on the ground has a pair of binoculars and the lamps are switched on one at a time as they are dealt with.

Fig. 18 is an enlarged view of a floodlight tower taken from a corner of the ground. This is the kind of view the observer on the ground gets when the units are being trained, except that only one lamp is switched on at a time.

The training will be simpler for installations where there are a larger number of

smaller groups, but the same ideal of even, vertical light from all points of the compass should be aimed at.

(14.6) The Training Plan

The training plan mentioned above should be laid out on the drawing-board, and may be made symmetrical. If there are 30 floodlights on each tower, the ground may be divided into 30 rectangles and a training peg put at the centre of each. Since the observer has his eye level about 5 ft. above the ground the beam axis of each will reach the ground some way behind him, but the near parts of the ground receive more spilled light from the bank of floodlights, and the slightly high training is, therefore, an advantage.

If measurements at night indicate that some alterations should be made to the training plan, these should be done without moving the symmetrical pegs. The ground observer takes up positions so many yards behind, in front, or left, or right of each peg, and so can repeat the performance from each tower without using four sets of pegs.

(14.7) Mechanical Design of Floodlights

Since considerable time is required to train the floodlights, it is clearly desirable to have some means by which each floodlight can be re-set to its correct position without difficulty. Pre-set devices are common on the more expensive floodlights, and usually consist of a lever which can be secured to the trunnion and which is held in position by a set pin. Subsequent adjustments are made by loosening the set pin and so freeing the lever. The value of this device depends on the person who cleans the fitting knowing which securing pin he may loosen, and some arrangement which is more foolproof is to be desired.

American practice is to use a scale graduated in degrees on the horizontal and vertical movements; this is satisfactory, but involves making a note of the settings of each floodlight. A simple system which works quite well is to provide each movement with a pointer and to make paint marks opposite the pointer when the correct setting has been determined.

Since the floodlight is to be trained below the horizontal and serviced from behind, it is convenient that the back should be removable with the mirror in order to obtain access to the lamp. The normal front-opening floodlight is more difficult to service.

It will not be easy by normal means to focus the floodlight for minimum divergence, and the makers should specify the distance of the lamp bulb from the mirror surface for this condition. These are small matters, but important to the engineers at the top of the tower.

(14.8) Optical Characteristics

For maximum efficiency from high towers, narrow beam floodlights having not more than 12-15 deg. divergence are desirable—at least for a proportion of the floodlights. The limits of the beams should be confined to the playing area as far as possible, partly because this makes for efficiency and partly because it reduces glare from the viewpoints of the spectators. The glare from a floodlight when only the lamp filament can be seen is quite small compared with that from the floodlights when the reflector is flashed.

As long as the beam is confined to the pitch, the beam angle can be increased, as this will mean that there is more overlap and the same average illumination can be obtained with lower average intensity and therefore less glare. For this reason floodlights whose beam angles can be varied between fairly wide limits are advantageous. Beam angles of 12-40 deg. may be required, depending on circumstances.

(14.9) Installations

Games of football have been played, quite successfully, with as few as 12 floodlights of 1,000 watts each; on the other hand, in America there are installations using four batteries each containing 250 floodlights. It seems that the load can be increased to any extent dictated by necessities of competition and the number of spectators.

The Continental grounds have installations of between 100 and 150 kw. and seem to be satisfactory. Frequently, extra illumination is obtained by over-running lamps by about 10 per cent. Although this shortens the life of the lamps considerably, it is not a serious matter as the hours of burning during the course of a year are quite small, and for any level of illumination considerably less equipment is required.

Discussion

MR. J. C. G. CRUMP (Hon. Sec., British Amateur Athletics Board): I am sure we have all listened to Mr. Peirce with great interest. I am absolutely ignorant about the intricacies of lighting, and what has struck me most forcibly is the depth of knowledge which Mr. Peirce has about the technical aspects of very many of our major sports.

I am not here as a lighting expert; we, in sports organisations, expect you, as lighting experts, to be able to solve our problems for us, and if you are not able to do so, you are not entitled to be regarded as experts. I am concerned with the promotion of sports and can only point out some of our difficulties to which we expect you to find the answer. If we exclude the sports which are purely for public entertaining—which are concerned more with people going to see something and not with the wider aspects of recreation—we have left all the sports which have physical recreation as their major object.

We are trying to get more people to play our particular games, and for that reason we must sooner or later come to a stage where we have got to get an increasing number of people to take advantage of the facilities for these games; from my point of view, i.e., that of athletics, we will have to make the best use of our limited number of athletics tracks. Of course we can only do that if we can use them during the hours when there is no daylight, and we must, therefore, have some form of illumination to enable them to be used in mid-week evenings, particularly during the winter. We must attract the public, so we must use the night hours for the purpose of getting them to come and pay to see our form of entertainment. At the present moment every branch of sport is competing with other branches because the only time for play is Saturday afternoon. If you can solve our problems for illuminating our sports and allow us to have floodlit meetings, I am sure there is going to be a great deal more sport for the public and more competition for the athlete and games player which will mean a rising standard in our national sports.

I am a little disappointed that Mr. Peirce did not refer in his survey, wide though it was, to athletics. The lighting of indoor games is no longer a problem because they have always been played in some sort of artificial lighting. The problems concerned with outdoor sports are more immediate.

I had the pleasure of seeing a big floodlit meeting in California last year, where the lighting was almost better than daylight—certainly better than much of the daylight during an English summer. There they had tackled the problem and found a solution, but in this country we have not, as yet, found a solution, consequently we have had only a limited number of meetings and even then such things as jumping and hurdling cannot take place owing to the lighting. Nor can the discus, the javelin or the hammer be thrown at night, because if they were all the officials and many of the players would probably be hurt or killed.

If you can solve this problem and give the public a form of entertainment at night, a form in which the athlete can throw and jump to his heart's content without being a

danger to officials or public, then, indeed, you will have made a major contribution to British sport.

MR. W. J. CRAYSTON (Assistant-Manager, Arsenal Football Club): As a professional football club, it is our business to give our supporters and the football public the best floodlit football. In 1928 we made our first experiment with lights but it is only since the war that we tackled the job on a large scale. In many quarters our scheme to instal the lights ourselves was considered too ambitious; however, our staff obtained equipment from many sources and with their technical knowledge and ingenuity erected an in-line lighting system good enough to attract and satisfy a crowd of 60,000 for the first game. In the last four years we have had matches at the Stadium with attendances of from 6,000 to 60,000 and under a variety of climatic conditions. Two of the games have been televised.

In spite of the initial success we were not entirely satisfied. We obtained the reactions and opinions of our own and opposing players and had helpful suggestions from spectators. Recently we called in an illuminating engineer for his observations and recommendations on how we could improve our existing installation.

During the early stages floodlit football was rather a novelty, but to be a success as a public entertainment the lighting must be of such a standard that the players can produce their skill and the spectators witness the spectacle without complaint.

Another factor is our climate. In our tour of Brazil a number of matches by floodlight started at 9.30 p.m., but we cannot imagine a crowd in this country suffering our mid-winter weather at such a late hour and then returning to their homes in the early hours of the next morning—transport permitting.

We do feel that floodlit football has a tremendous future. For certain matches the Football Association has given the necessary authority, but before league or other competitive matches at a high level are permitted all clubs will have to possess a lighting installation of a certain standard so that one club with greater experience of floodlit football will not be deemed to have an unfair advantage.

The game under lights with 60,000 present is a wonderful spectacle, but organisers have also to be concerned with the safety of the public. Ordinary lighting is required at turnstiles, corridors, exits, etc., but above all, an emergency generator or other means of supply has to be available should the normal source of supply fail.

We also feel that floodlighting has great possibilities for the encouragement of training in recreational activities for those who have no opportunities other than during the evenings.

Recently on an amateur ground in London I saw a peculiar apparatus which gave sufficient light for the players to run round the track and to practise shooting at goal. Another club has mobile lights. These consist of lamps erected on posts fastened to a wooden base and are placed in position on the field for training as and when required.

In my opinion, for all sports requiring lights, whether outdoor or indoor, the lighting experts should endeavour to illuminate the scene so that no complaint or protest will be forthcoming from either the performers or onlookers.

MR. L. G. APPLEBEE: I am not speaking from the point of view of a lighting engineer but as an official of the Southern Counties Amateur Swimming Association.

I was very interested in Mr. Peirce's remarks about swimming baths and I thought that some more information for lighting engineers might be useful. To us in the swimming world there are two kinds of swimming—competition swimming and what we call "the bathers." In competition swimming, under no circumstances is underwater lighting used, mainly because the competitors in No. 1 lane and No. 6 lane refuse to swim if the underwater lighting is on.

The question of safety is quite a good one, but I have never seen the underwater

lighting used for that purpose when the general public is in the bath. At the baths where my club operates, we have very efficient underwater lighting and it is only used for fifteen minutes once a year when the club put on a water ballet at the autumn gala.

As a competition official I see a great many baths but I have yet to see one which is what I would call adequately lit for competition galas. In winter most baths are covered by a wooden floor and used for dancing, etc. All the architect seems to think about is getting the whole hall evenly illuminated, including the spectators, even in the galleries. Watching a swimming gala is the same as watching a circus or a play or an athletics meeting. You do not want light on the spectators but on the area where the action is taking place, and never are the fittings designed to give a high concentration in the area where the racing is taking place. In a swimming bath you get little reflection from the water; for the Olympic Games at Wembley it was thought that the lighting used for ice hockey would be adequate for the swimming but it had to be increased. This is because there is reflection from the ice, but not from the water.

In the illustration of the boxing ring I noticed that Mr. Peirce was apparently using wide dispersive units. In my experience you do not want dispersive units in a boxing ring, which must be treated in the same way as, for example, a theatre, with semi-hard directional lighting. Two of the best examples of boxing-ring lighting were at Earls Court and the Royal Albert Hall where the cut-off was confined to just a little way over the ropes. There was no light on the audience but the beam intensity was so great that no matter where the spectator was, he could follow the boxer's fists from the highlight on the gloves.

MR. B. C. OSSITT: I would like to have Mr. Peirce's views on the solution of a problem which I think is even more important than that of professional football, namely, the lighting of sports fields and grounds for amateur sport and amateur football.

I am thinking of grounds like those of the leading amateur clubs which are used primarily for the playing of a game and accommodation is provided for only a few hundred spectators. I would like to know what he regards as the minimum lighting requirements for such grounds.

I think such installations, if within the purse of small clubs, would greatly add to the enjoyment of players and spectators.

MR. C. J. KING: It is particularly refreshing to find in a talk on sports lighting that there are other sports than professional football.

I was interested in the comments about ice rinks. I know a rink which is used for 54 hours a week for curling. At 54 hours a week this is a very paying concern, and the lighting is on for about half that time. The lighting has been installed by presumably competent engineers, but no attempt has been made to shield the fittings with louvres. Standard industrial reflectors with 500-watt lamps are used. If they were louvred in some way it would make an immense difference to the pleasure of playing, and would not affect the lighting on the tracks. There is no mention in the paper about louvering of fittings; perhaps Mr. Peirce could comment on this.

On big fields the loads are going to be very substantial—I believe 100 kw. is being considered. Will such a load be allowed during peak periods? If not, the lighting engineer will have to come out in the evenings to do his tests.

MR. I. M. HEALD: I noticed on the slide of the badminton court, two lighting units in a vertical position, which I thought were too glaring.

I have played in a number of badminton halls throughout the country, and I found that a fitting similar to the one that was shown, or even bare lamps with a muslin cover, when mounted horizontally and a little higher than shown in the

illustration, give a far better result. The lighting is also improved if they are fixed farther away from the court.

MR. A. CUNNINGTON : The discussion has concentrated on the lighting of large areas. I do not think this is very surprising because while lighting for indoor and similar sports has been dealt with and more or less settled, there is still a good deal of further investigation required before we can be satisfied with the lighting of large areas, such as athletic grounds and football grounds, and obviously there is much at stake, as was made clear by Mr. Crayston. There is room for considerable expenditure and I feel it is quite likely that some of the installations have not been successful in the past because expenditure was too limited to secure a thoroughly satisfactory lighting installation.

There are two aspects of the problem, the players and the spectators. It has been suggested that these two points of view are conflicting, but I do not see why. If the game is perfectly lighted the spectators will be quite happy; if they are not happy, surely the reason is that we have not got over the glare problem which is inherent in almost all the present sports lighting installations. Wherever you put the fittings you have to direct them to avoid getting the light in the eyes of the spectators. It is just possible that that is some condemnation of the arrangement at the Arsenal Stadium. If one is in the upper part of the stand the facing lights are entirely cut off, but in the front of the stand there is a certain amount of glare. So long as there is anything of that kind the public will not be entirely satisfied.

I do not think we have yet sufficiently realised the importance of downward-directional lighting. We found that floodlighting across a railway yard was confusing, but when the lights were placed on high towers less light got into the workers' eyes and conditions were greatly improved. Obviously we must spend a certain amount of money in getting real height—90 ft. is much better than 60 ft. I think that is the crux of the matter. We must not be too worried about illumination on the field itself. I think more investigation towards tower lighting with downward distribution of the lighting may lead to considerable improvement.

MR. C. PELLOW : I agree with Mr. Cunnington. I resided in Sydney, Australia, for a period some time ago and had an opportunity of visiting their cricket ground on several occasions. If my memory serves me aright, the ground was illuminated by means of four towers situated at the corners of the field, some 130 ft. high with about 140 floodlights on each. A costly installation, but the results were good.

I also visited a tennis court with dark green gravel and with a perfect lighting installation; alongside it was a court with light sandy gravel and a very inferior lighting installation. People using the courts invariably played on the one with the light ground and poor lighting rather than on the court with the dark green gravel and good lighting.

With regard to ice hockey, at Wembley an appreciable amount of electric discharge lighting was blended with the tungsten system with good results.

MR. E. C. LENNOX : I would have liked the author to give a more definite indication for the lighting of football grounds. I am certain from his paper that the author has a definite opinion about the best position for the lighting units. To me it would seem that the lighting units should be placed on a diagonal line from corner to corner, mounted at such a height that the angle from the top of the lighting unit to the centre of the field is approximately 70 deg., and placed sufficiently far behind the goal line to make the angle to the centre of the goal line some 12-15 deg. This position may not always be possible, owing to location of buildings at the ideal point, and lighting units may, therefore, not all be at the same height. I feel that the author favours the idea that four lighting towers are sufficient and that any additional towers merely

provide additional glare points for both spectators and players. I have found that players suffer very little from glare in grounds lighted by only four lighting units at a height of approximately 85 ft., but that the referee and linesmen do suffer to some extent, because their view of the ball very often is from a greater distance than that of the normal player. I suggest that to overcome this, these persons—as distinct from the players—could wear a long peak cap. It is appreciated that with proper fixing of the twenty or so floodlights at each lighting tower, only one or two of the actual floodlights would appear glaring in any position.

Regarding the question of the cost of this form of illumination, it should be appreciated that the Electricity Board will receive a sum of approximately £3 only per game from a lighting load of 100 kw. The annual revenue, therefore, would be relatively small, whereas such a load impinging upon the Board's "peak" might cost the Board a sum of over £400 on its annual account to the B.E.A. It is essential that use of the installation for maintenance, or other purposes is *not* allowed during possible peak hours.

MR. R. O. ACKERLEY: I was reminded by Mr. Applebee's remarks that while we have been talking about the general public and the player, there is sometimes a third party, namely the specialist members of the public. Mr. Applebee said that he did not like the type of lighting over a boxing ring which had a diffused distribution; he wanted something highly concentrated. I remember many years ago concentrating units being installed over a well-known boxing ring with the result that an instantaneous picture of any boxer showed him with a very heavy shadow on his body, so much so that a white hope came out in the Press photographs like a negro. Press photographers refused to come to the boxing ring concerned until the lighting had been altered to permit the taking of satisfactory instantaneous pictures of the boxing.

MR. A. T. HARVEY: I agree with Mr. Crump that Mr. Peirce has covered a very wide field but I am surprised that he has offered different solutions for games which are quite similar in the demands they make upon the eyes. The dimensions of a football pitch are similar in proportion to those of a tennis court or a badminton court, yet Mr. Peirce suggests four floodlighting towers for the football pitch, and lights along the side for the tennis court. For badminton, he offers something entirely different and from the photograph that he showed, the result seemed rather glaring.

When playing on a tennis court lighted to the standard suggested by Mr. Peirce, I have found that it is quite difficult to see a fast ball quickly. After a few minutes, when one has become accustomed to the conditions and played oneself in, one can play quite normally except for the difficulty of taking a fast service confidently, or returning a fast ball well.

MR. E. A. CATTLE: With regard to the small-bore rifle-range work, I have tried out the idea of controlled glare, but I am afraid it was not a success. Perhaps Mr. Peirce does not do much shooting, but the average marksman does not shut one eye; he has both eyes open and the glare in the open eye is so great that it fogs the other eye. I have tried both kinds of background, but still find that black is better.

One point which has been forgotten is reflection from the rifle barrel between the two sights; this occurs in spite of efforts made to keep the barrel as dull as possible. My experience is that the minimum amount of general lighting is needed for the ease of the marksman.

As far as football lighting is concerned, I do not think anyone really knows yet which is better—line lighting or corner lighting.

I would like—as one who has to see football directors who have received quotations from various firms—to have some guidance on what to expect. Recently I was shown six quotations, all from well-known firms; the proposed loads varied from 36 kw.

to 120 kw. for the same job. Somebody was right and somebody was wrong—but who ?

It must also be remembered that football clubs need to be advised about erection of floodlighting apparatus and connection to the supply. I know of one instance where connecting the installation to the supply was left to the club, and application for a connection was refused, simply because it was not appreciated that it was an "off-peak" load. I endorse the remarks of Mr. Lennox. It appears that unless an arrangement for "off-peak" loading can be made, all units will be at 5½d. per unit. The Electricity Board charge the first 160 at 5½d. per unit, and the remainder at 1d. per unit.

MR. PEIRCE (in reply to the discussion): I wonder whether Mr. Crump is familiar with the lighting installation at the White City, and if so, whether he considers there is sufficient light for an athletics meeting? My own opinion is that lighting as used for football in this country would be inadequate in quantity, particularly for the field events. The problem is an economic one rather than technical, and a very large number of floodlights are required, as in the Californian example mentioned. With Mr. Crump's remarks on the need for adequate facilities I am in full agreement.

Replying to Mr. Crayston, I would like to congratulate the Arsenal Club on their pioneer work, which has proved floodlit football to be a success as a public entertainment. The results are excellent, but I do think that a revised plan for training the floodlights would reduce glare to spectators and increase the amount of light on the pitch. Every club with equipment for lighting should appreciate the importance of a scientific training plan for the lights and of maintaining accurate focusing.

I agree with Mr. Applebee that a high concentration of light over the swimming area is desirable for competition swimming, and that this type of lighting is frequently not provided. I would have thought that for diving events the use of underwater lighting would be an advantage. As regards lighting for boxing, it is true that it is desirable to confine light to the ring itself, but it is essential that the lighting should be somewhat diffuse. It is for this reason that deep curtains are used for controlling the cut-off rather than using cut-off fittings, although the latter would be simpler mechanically.

The lighting of small football grounds mentioned by Mr. Ossitt is important. Lighting for play can be quite satisfactory with as few as 12 1,500-watt units arranged six on each side of the ground. If there are spectators, it might be desirable to double this quantity, but such an installation should not be beyond the purse of a small club.

In reply to Mr. King on the subject of ice rinks, I think it is indeed desirable that there should be some louvering or cut-off control of the lighting fittings. The principle must not be carried too far, however, or there will not be enough light on the vertical plane. With regard to testing football floodlighting in the day-time, it is possible with the method described to train the floodlights one at a time and to switch each floodlight off as it is trained and focused, thus keeping the load at 1,500 watts.

Mr. Heald mentioned badminton courts. With a diffusing fitting, the distribution depends on the projected area in the direction of view. When the fitting is horizontal, a foreshortened view is obtained when seen from the ends of the court, but with the vertical type recommended, the projected area, and, therefore, the candlepower, remains more or less constant at all angles of view. The mounting height and the distance from the net posts must be controlled by the size of the hall.

Mr. Cunnington is right to emphasise the importance of mounting height and of consideration of the players' and spectators' requirements. Other things being equal,

the installation with the greater mounting height must be the better, and it is well for everyone concerned to keep this in mind.

I was extremely interested in Mr. Pellow's comment about Sydney. I was also interested in his remarks about lawn tennis lighting, where players used the light-coloured court rather than a green court which had better lighting. Perhaps the light courts were more attractive from a distance, although the green was probably better to play on. Regarding the use of a proportion of electric discharge lighting for ice hockey at Wembley, I think this is probably a good thing, as the coldness of the colour would be an advantage.

Mr. Lennox is correct in wishing to tie-up the mounting height with the distance of towers from the field, and the angle of 70 deg. from the centre of the ground is probably a good guide. Positions, however, must be chosen with local conditions in mind, and the best compromise arrived at. As mentioned in my reply to Mr. King, training of the floodlights should be carried out one at a time to avoid causing heavy loads during peak hours.

In reply to Mr. Harvey, I do not agree that the different games he mentions make similar demands on the eyes. In lawn tennis, a player is at a disadvantage if he cannot see to serve properly and "corner" lighting as used for football would cause this difficulty. In badminton, advantage is taken of the fact that the shuttle is translucent, and so many shots are taken overhead that any other lighting positions cause considerable disability to the players.

Mr. Cattle recommends that the minimum amount of general lighting is needed for the ease of the marksman, but I would refer him to conditions that obtain in daylight in open-air ranges. I understand that difficulties of vision occur only under artificial light. Regarding football floodlighting, I think the choice between line and corner lighting must be made according to conditions, and as to total wattage—as much as the club can afford! No one can say that 120 kw. is too much or that it is impossible to play with 36 kw., and it should not be difficult for the customer to differentiate between the two schemes. It is more difficult to appreciate the increase in cost and the improvement to be expected for every 10 ft. increase in the height of the towers.

Additions to the List of Members

The following applicants have been duly elected by the Council to membership in the Society and their names have been added to the list of members:—

CORPORATE MEMBERS:—

Barnard, J. W. ..... c/o The Electricity Supply Commission, P.O. Box 1091, Johannesburg, SOUTH AFRICA.
Cartwright, A. J. ..... 66, Southgates, LEICESTER.
Clare, V. L. ..... "The Limes," Johnsons Road, Whitehall, BRISTOL.
Fleming, J. O. C. ..... c/o Enterprise Hatcheries, Saintfield, CO. DOWN.
Foreman, F. C. ..... 33, Ashburton Road, Croydon, SURREY.
Gilbert, H. ..... 5, Fox Wood Grove, Roundhay, LEEDS, 8.
Heath, F. J. ..... 2, Highfield Court, Highfield Street, LEICESTER.
Hornsey, D. R. M. ..... 19, Central Boulevard, DONCASTER.
Isle, E. D. ..... "Sandown," 75, Tinshill Road, LEEDS, 6.
Shackleton, N. ..... Yorkshire Electricity Board, HULL.
Smare, D. L. ..... Physics Dept., Technical College, BRADFORD.
Vaughan, C. H. ..... Elder Grove, 5, Dunkirk Lane, HALIFAX.
Wilford, L. A. ..... 21, Mossdale Road, Sherwood, NOTTINGHAM.

OVERSEAS MEMBER:—

Kher, M. M. ..... 50, Civil Lines, Nagpur (M.P.), INDIA.

Register of Lighting Engineers

The Council has accepted the following application for inclusion on the Register of Lighting Engineers:—

Mr. K. D. Weguelin.

Lighting in Australia and Europe

By D. C. B. MACLURCAN, A.R.I.B.A., F.I.E.S.(Aus.)

It occurred to me when writing the notes for this address that it should open with a description of how the invitation from your Secretary reached me—or rather how I reached it. In the circumstances it was all somewhat overwhelming, and it is my hope that I can do justice to this occasion and that you will not be disappointed.

My wife and I had been travelling in Europe since early in December, 1952, having brought our car from Australia to Genoa. As you know, it was a severe winter and we had experienced little else than snow, ice and fog, except in the mountains where we were ski-ing. The car had been three times buried in snow, but we had grown used to the mountain roads and the skidding, and our journey was often made easy by the courtesy and kindness of the people in the various countries.

On March 7 we had left Munich with the intention of driving that day to Stuttgart, then on the following day to Nurnberg. Forgetting it was a Saturday, we travelled on the autobahn to Göppingen to visit the Märklin toy factory (being an enthusiast for model railways I wanted to see them being made). Of course the factory was closed. This was frustration No. 1.

At Stuttgart it began to rain. It rained from there to Nurnberg. We entered this fascinating city in a heavy downpour without a town plan, and the task of finding our way to Ludwigshöhe, some 10 miles away, where we expected mail to be awaiting us. Ludwigshöhe is a pretty collection of houses on a wooded hillside and has a system of numbering not previously experienced by us. I think the first person to erect a house in the district gets No. 1, and then each succeeding pioneer is allotted his number in order of settling, and so on up to more modern times. But there is no recognisable relationship to street or town plan. So No. 26 stands beside 13, 51 beside 2, etc. This was frustration No. 2—and it was raining heavily.

At the end of an hour's searching for No. 13A (a further subdivision you will observe, the origin of which has been forgotten) we managed to get the car bogged in a field and were soon well covered with mud. Marshall Aid got us out in the person of a kindly American. Frustration No. 3.

After this I walked and, tired out and dirty, found the correct address—and the invitation to this "distinguished Australian" to address you to-night. To make me feel perfectly at ease one of the letters listed the really distinguished persons who had spoken before at your annual meetings. How could I possibly prepare a dignified technical monologue while travelling in Europe adrift from all my books of reference and I.E.S. data? It was my decision there and then to speak informally and stay clear of technical matters, a decision which demands from me an apology.

I am tempted to tell you of a Czechoslovakian friend of mine who had great success along certain lines in Australia. He used to say to the person of his choice, "I am a poor migrant from Central Europe. I do not speak much English, but I love you." So do I not speak much of lumens and luminosity, of photometrical matters or surface brightness, but I love you—no—but we are friends, I hope, anyway, and you must please forgive me.

First, I would like to tell you a little about my country and the history of the I.E.S. there. We are a young nation, only just 150 years old, but if you have not visited our larger cities it is hard for you to imagine their size and their busy character. In Sydney there are over 1,700,000 people, yet the vast continent, into which the whole of Western Europe could be fitted, has a population less than that of London. Conditions, therefore, are different from those you know. Distances have a different value. It was possible for me in a fast car to drive 580-odd miles between Sydney

Presented at the Annual General Meeting of the Society held in London, May 12, 1953.

and Melbourne in 9½ hours, travelling long sections of the road without a house in sight. In this country the character of our nation has developed qualities of independence and initiative which now require tempering with the wisdom which is coming with greater maturity.

Politically the country is divided into seven States. In two of these, New South Wales and Victoria, some 20 years ago during the depression, an Illuminating Engineering Society came into being and each developed along similar lines. Each now has about 300 members. Individual societies followed in South Australia, Queensland and Western Australia, and it became obvious that some form of central government would be advantageous to all. Conferences were held and a satisfactory scheme was evolved for a National Council which would co-ordinate efforts, regularise procedure, and deliberate on and execute plans of national importance or, at least, of mutual interest. A conference of this Council is held in one of the States annually, delegates travelling, for instance, from Perth to Sydney, through 35 deg. of longitude. Six such conferences have been held.

One of the most complex problems before the National Council has been the professional standing of members and the use of designatory initial letters. As in your Society, membership of our Society is open to anyone interested in lighting and there is no technical qualification required for any but the two highest gradings, namely those of Fellow and Member. We would not like the Society to become a purely technical body, but rather desire it to be an association of the many professions interested in lighting. In the various State societies we had the following grades—Fellows, Members, Associate Members, Sustaining Members (I always think this a charmingly apt description of their function) and Affiliates. Members came from all sections of the technical and professional community—electrical tradesmen, architects, sales representatives and business executives as well as others, and many had been admitted to the grade of Member in earlier days before a rigid and high standard of qualification had been set. It was felt that we could not give a blanket authority for all such persons to make use of the letters M.I.E.S. to indicate their professional standing until, at the very least, we were assured that 75 per cent. of such members in each State Society had, in fact, the technical training, a relevant university degree or an educational diploma. So a survey was made, and as a result in March last year all Fellows were given the authority to use the appropriate letters after their names. It was my privilege to be the President of the National Council at that time, and I remember well receiving a letter from your vigilant Secretary in which he pointed out that the letters F.I.E.S. had nothing to distinguish them from those used by Fellows of your Society and that the letters M.I.E.S., though not used by the I.E.S. in this country, indicated membership of another body. My bad memory may be doing him injustice but I think that was the gist of the letter. Our vanity was greater than his vigilance for we had already decided that the letters should be followed by the abbreviation (AUST) in brackets, but our reply to him was couched in courteous terms.

The survey of the "member" grade took more time and it was not until October, 1952, that satisfactory data came to hand from each Society and the National Council gave its authority for all full members to make use of the letters M.I.E.S. (AUST). Concurrently Certificates of Membership were prepared and issued to those entitled to hold them.

We feel that this has been a big step forward for us, because we have now established our standards publicly on a high basis of sound technical education, and it brings us more or less into line with your idea of a Register of Lighting Engineers. It should give you an idea of our youth, though, that this important move was completed less than a year ago.

I imagine our annual programme is similar to yours in many respects. Meetings

are held each month at which technical or semi-technical papers are heard, discussions and debates held, and exhibitions of equipment given. Sometimes visits are arranged to important factories where members may see lamps and electrical equipment being made. Such visits usually attract about 100 members. The attendance at monthly meetings in New South Wales varies between 40 and 100.

I can recall many memorable occasions and excellent evenings, but must specially mention the visit to Australia and the address given by the late Sir Clifford Paterson. This was preceded by an informal dinner during which this kindly gentleman won us all and made many friends who will always remember him.

There is one particular virtue of the Australian I.E.S. which is very noticeable to me and which I would like to mention; that is the pleasant social grace of "friendliness." Men from varying walks of life meet within the Society. It is not like the Royal Institute of British Architects or the Royal Australian Institute of Architects, or the British Medical Association, where one meets almost exclusively the members of one's own profession. In it we have electrical engineers, opticians, scientists, mechanical engineers, electrical tradesmen, sales representatives—and even architects. With this variety we all try to appreciate the diverse points of view and find that the courteous ability to listen sometimes instead of preaching, to pretend to understand occasionally when we are thinking "Really—what nonsense!" is the perfect culture for this easily caught disease of friendliness. And out of friendship comes both mutual assistance and progress.

I think that one of the finest characteristics of my Society in New South Wales is expressed by the fact that its president last year was a German—albeit of some decades residence in Australia and an accomplished gentleman. Moreover, the able German scientist, Dr. Dresler, has addressed us and is contributing enthusiastically to the work of the Society in Victoria, as well as to that of the National Committee on Illumination about which I will say a word or two in a minute. He is engaged by one of our Government Departments as a lighting engineer and takes active interest in all Society matters.

The proximity of your Continental neighbours to England would probably tend to belittle the importance of such aspects of our social life, so I would remind you that our somewhat lonely detachment from Europe makes us far more insular in outlook than you, and until the post-war years foreign tongues were rarely heard amongst us.

In 1950 or 1951 the International Commission on Illumination invited Australia to form a National Committee, but though a member of this Committee I am afraid I am rather vague about some details of its activities.

The Committee includes representatives from the following organisations :—

Department of Labour and National Service
The Standards Association of Australia
The Institute of Optometrists
The British Medical Association
The Sydney County Council (Electricity Supply Authority)
The Royal Australian Institute of Architects
The National Standards Laboratory
The Illuminating Engineering Society.

There are some others but the names escape my memory.

We were first allotted the Secretariat on Architectural Lighting and, after some eighteen months of spasmodic discussion found we had an incredibly short time in which to have our report ready. That report must have been one of the most negative documents tabled before the august parent body, for we simply said we did not think there should be a Secretariat on Architectural Lighting—and asked for another job.

But Australia was able to send Dr. Giovanelli and Mr. Brentwood to the Conference in Stockholm and gained much by their experience.

In the meantime the recommendation of our report was adopted and instead we were allocated first the Secretariat on "Daylight" and later the Secretariat on "Estimation of Comfort in Lighting." I happen to have with me the draft terms of reference prepared for the sub-committee formed to work on the latter subject and will read them so that you can have an idea of the procedure we follow. They are:—

(1) A study of the factors influencing comfort in lighting, including the methods of measuring the effect on comfort of such factors and the assessment of their relative importance. (2) The establishment of qualitative and quantitative conditions (derived from the above factors) to provide comfort in lighting, and the presentation of such data in a form suitable for practical design purposes.

I trust my able colleagues are hard at work.

I must say I fully agreed with the report on Architectural Lighting, and in fact was one of the prime movers in its composition. I do not think there is any such thing as architectural lighting. There may be "lighting of architecture" instanced by the floodlighting of a building externally, but the often accepted definition of lamps placed in coves, luminous panels, or decorative strips of light on columns as "architectural lighting" seems to me to be a misnomer.

I believe, though, that means of artificial lighting are now a tangible medium of expression which is available to the architect in his work as a designer and certainly no longer serve only the single purpose of making things visible. Light can be used to enhance proportions, colour, and texture, to create the appearance of interesting spatial relationships, to cause dramatic effects, harmony and discord, seeming comfort and peacefulness or apprehension. It can be used very much as part of architecture but I think only a very few architects know how—and, unfortunately, very few illuminating engineers know how. I propose that we establish a school where men from these two professions may go for special training, the architects to learn something of the scientific side of lighting, and the illuminating engineers to learn to detach themselves from commercialism and salesmanship!

In industrial architecture lighting probably has reached its pinnacle of perfection, and improvement will take place mainly in lamp design. Nearly everybody knows now how to light a factory artificially; but there are other types of architecture where there is room for improvement. In commercial office buildings, for instance, in schools and in churches. In eccleciastical design there is probably the greatest single creative opportunity still awaiting exploration by the lighting engineer.

At home there is widespread and enthusiastic acceptance of the fluorescent lamp, and this has had a most noticeable effect on lighting practice. Really, I think it is being over-used, the song of its advantages being sung "too loud and clear," to quote from "Through the Looking Glass." It is being incongruously strung up in some of our churches, made into whirligigs and hung in cafés, and suspended as detached 4-ft. lengths of glowing white light where the softness of one or two shielded incandescent lamps did the job with greater aesthetic value 10 years ago. But not all engineers have succumbed to its special appeal, and the use of the incandescent lamp is still advancing.

As in most countries, you will always find in Australia some gem of architecture which proves generalisation to be at fault. In the sprawling suburbs of Sydney, Melbourne, and Brisbane, in the midst of the most appalling mediocrity, here and there are examples of the most advanced domestic architecture in the world—and the most advanced lighting practice. In our cities new office buildings are being erected. Some of these will have little merit as examples of contemporary thought—others will excel. Similarly in our schools, churches, factories and shops there is advancing, static and retrograde design in architecture and lighting.

In domestic architecture, a few architects have realised the valuable combination available with fluorescent and incandescent light sources. These men are our leaders and they are using lighting as a medium of expressing a variety of ideas. Solid symmetry or assymmetry is enhanced by them with light used as a quantitative ingredient. Thus, one wall in a living-room may be painted a different colour from the others, or be constructed of a different material, or present a different texture, and may be mildly floodlit with directional reflectors whilst general illumination is provided elsewhere with fluorescent tubes in coves, recessed panels or louvered down-lights.

Great stress is placed on the value of local light where it is needed either temporarily, as for reading before an open fire, or permanently, in the lighting of a dining-table. A number of power outlets is considered the best answer to the first requirement so that one or more standard lamps may be used. The fluorescent tube has not yet successfully taken the place of the incandescent lamp in this fitting.

Fluorescent lamps are, however, being used more and more in houses in Australia, despite the drawback of shortened life from constant switching. The introduction of the starterless lamp is a marked improvement.

As regards schools, a very great number are designed by the State Government Architectural departments and some of these lack architectural merit. Experience based on long years of a public education system has taught the architects of these departments that certain standards are desirable, but there is a lag behind the times in applying the lessons; what was desirable 20 or 30 years ago is what is often done to-day, *not* what might be done in an attempt to fill the needs of the future. Only the last endeavour produces advancement. Advanced design is more noticeable in the fewer private schools than in the many State schools, but in both incandescent lighting, as a means of general and local illumination, still has an important place. This, I think, is largely because the manufacturers concerned have correctly interpreted the competition of the fluorescent lamp and concentrated on improving reflectors and fittings; another reason is the high initial cost of fluorescent installations. This factor of high initial cost is one which often operates against fluorescent lighting when available funds are limited, as they generally are for private-school construction.

I think it would be safe to say that new church construction in Australia represents some of the best contemporary thought in the world, but I am not sure that the lighting is marching hand in hand with the architecture. As I mentioned earlier, it is my opinion that church lighting is one of the only great challenges left to the lighting designer. There are very special requirements in the house of worship. Certain parts, such as the altar area, need a concentration of local light for good visibility, certain parts need high lighting, consistent maybe with the creation of an atmosphere of mystery, sufficient general light must be available for the congregation to read without discomfort without detracting from the soft air of mystery, and the dramatic side of religious ceremonial must not be forgotten. A well-lighted church would probably be as complex as a theatre to operate. Usually lack of funds necessitates compromise which calls for profound understanding and great skill on the part of the designer.

In my office, where many modern churches have been designed, we usually light the body of the church with some form of fitting diffusing light in all directions, the fitting itself being visible. Side aisles and narthex often have lamps recessed in the ceiling so that they are not visible but throw downwards only. This makes a contrast with the nave where walls and ceiling are in direct light. We use both incandescent and fluorescent lamps, as factors of expense and desirability allow. Special reflectors are used to light the altar, and wherever possible are hidden from the view of the congregation.

All this is in new work and is quite sound. What you really should come to

my country to see are some of the ghastly applications of modern technique to churches designed for the days of rush lights and oil lamps. I wish ignorant people would leave these old buildings alone. I think of one church where 40-watt hot cathode lamps in open enamel trough reflectors have been fixed vertically to the columns flanking the sanctuary arch, and carried in pairs on each column all the way down the nave. There are others as bad. I strongly suspect an enthusiastic sales representative to be the criminal.

It is in the field of shop lighting that we have advanced most I think, and this view I still hold after seeing very good shop lighting in Europe. In this field there is a genuine spirit of co-operation between the architects and the illuminating engineers and some very courageous experiments have been made with fluorescent lamps, incandescent lamps and with combinations of both. There is a willingness to experiment with new ideas and, though the results are not always perfect, we are learning something on each job. At present there is a vogue for what is called the "louverall" ceiling using fluorescent lamps, either hot or cold cathode, placed on the actual ceiling of the shop but screened from oblique view by an elaborate layer of eggcrating. It is a most expensive installation but goes very close to providing perfectly shadowless lighting.

Shop window lighting at home is generally not as good as some I have seen in Europe, though it is not far behind. However, I am bound to say that it is mostly rather better than what I have seen in London. I have the impression that you are inclined to wait a little behind the most advanced ideas of to-day in much of your lighting, but that when you do decide to do something good it is usually quite startling —like some of the Exhibition buildings for the Festival of Britain. In Bristol I came across the usual exception. In Broad Mead in that city there is a very good example of the best trend in contemporary architecture and lighting in a shoe shop.

Having told you something of Australia, I think I might mention my reasons for leaving it. Many architects there look towards Europe not only for the glories of its past, but for the excellence of its contemporary architecture. Some there are who look only towards America for the architecture of to-day, but I privately think that the excellence of American periodicals leaves little to be seen in that great country. Also I love ski-ing and the European Alps offer everything to a skier. So we have come to Europe to go ski-ing, to study school architecture in particular and all architecture in general, and to observe new trends in lighting buildings.

Where can I commence to tell you about the tremendous impact of Europe on an Australian? The varied national characteristics of the Italians, the Swiss, the Austrians, the French and the Germans have impressed us vividly. Possibly it is only the detachment of our isolation which equips us to see clearly much in so short a time, in spite of being hampered by not knowing the languages.

Indeed Europe has been a conversational adventure beyond my wildest dreams. Do not worry about languages, we were told, because everybody speaks a little English. But our car was put ashore in Genoa on a bitter day of wind and ice with a flat battery and almost flat tyres. It took me two and a half hours to get it through the customs and towed to a garage—because I could not speak Italian. If I lived in your beautiful country so close to the Continent I would speak at least German and French and certainly will make a point of learning more of these languages before coming to Europe again.

In lighting I found much to remember—especially in the field of display lighting. There is a noticeable trend towards grouping several small reflectors giving direct downlight and minimising indirect light. The arrangement of the units is most important and I saw some very beautiful groups using looped flexible conduit in such places as jewellers' windows where the exquisite decoration was secondary only to the best

articles on display. Great use is made of strong colour contrasts. Pink and black; gold, grey and black; pale green, grey and russet brown; chocolate brown and silver grey. I remember especially a shop doorway in Zurich. The door was fully glazed with elaborately etched and obscured glass. The jambs and rails were in black lacquer, the frame was deeply coved to accommodate pink fluorescent tubes and was lined and moulded in black and gold. The pink light softly fell all round the door, faintly yet distinctly accentuating it, in the otherwise simple façade.

I was repeatedly impressed by the discriminating use of direct light. The important contribution to drama in architecture which is available through the medium of direct lighting is obviously fully understood by many designers—at least in Italy and Switzerland.

In Switzerland I visited many of the stores owned by the Migros-Genossenschafts-Bund. These are co-operative stores organised on the most advanced system I have yet seen, and they incorporate many interesting ideas. I spoke for some time with one of the directors, Herr Angst, and he gave me a very good lesson in store lighting. He decried the modern tendency to overlight shops, instancing America as a country where too much light was often used. He said that his organisation had learned through experience that there was a very critical optimum to be struck between bare visibility and garish showmanship. Taking me to one of their latest buildings, he surprised me with the low level of general illumination, but was able to show me many portions of the store where local lighting was used with very good effect. I found, however, both the inside and outside of the building a bit depressing, though I did not say so because it was not due to the lighting. There was too much use of dull grey and orange, surely a most unexciting combination of colours.

Both in Italy and Switzerland I saw some new ways of suspending that most difficult of lamps—the fluorescent tube. To date at home we seem to have bogged down on simple means of suspension such as vertical rods or chains, and most of our fittings are bulky because the ballast is carried in a housing placed on the top of the reflector. In the two countries mentioned, advanced designers tend to place the ballasts away from the reflectors, either on the ceiling or in the ceiling, with the reflectors hung from rods placed in diagonal repetition or in pairs as a V; oxidised brass as well as chromium plate was used with faintly coloured lacquer or baked enamels. It also seemed to me that a greater sense of delicacy prevailed in the use of line and profile, colour and texture, so that often enough the most elaborate contemporary chandelier somehow did not predominate yet still maintained the importance due to its function. In Australia designers have not yet been able to achieve this exquisite balance between form and function and most light fittings available from stock supplies are clumsy, ill-conceived creations which are very hard to use in contemporary architectural work. The best in Australia has to be imported from Europe and England—the worst in Australia is made to cater for the popular taste, which is not of a high standard. When the passenger liner *Monowai*, and later the liners *Manoora* and *Kanimbla* were being refitted after the war, my firm was called in as architects to design the public rooms. We found it almost impossible to buy the lighting equipment we needed from stock supplies or to have it specially manufactured at economical rates, and, therefore, much of it was brought to Australia from England.

When the notes for this address were finally put together and I read through them, it all seemed something of a ramble through the woods. I can only hope that you have not found my observations too disjointed and I apologise again for speaking somewhat informally and from a faulty memory.

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